We Claim:

1. A method for electronically controlling at least one wind energy installation without a gearbox, the wind energy installation having a wind turbine with a generator unit including a synchronous generator, a diode rectifier, and a field controller, the method which comprises:

using a control apparatus for, based on power electronics, setting or regulating a torque of the generator and therefore a rotational speed of the turbine to prevailing wind conditions for producing a maximum power in the wind energy installation; and

as a function of the prevailing wind conditions, switchably operating the wind energy installation in a control or operating mode with a variable rotor speed and a variable turbine rotational speed ω or in a control or operating mode at a predetermined fixed turbine rotational speed ω^*.

2. The method according to claim 1, which further comprises: forming a group of wind energy installations by using a capacitive DC voltage intermediate circuit to couple a plurality of wind energy installations without gearboxes.

3. The method according to claim 1, wherein the wind energy installation is located on a sea and close to a coastline.

4. The method according to claim 1, wherein the wind energy installation is located above a waterline of an ocean.

5. The method according to claim 1, wherein the step of setting or regulating the torque of the generator and therefore the rotational speed of the turbine is performed by controlling and varying a field strength of an excitation field for the generator.

6. The method according to claim 5, which further comprises: producing the excitation field of the generator by using a mixed excitation system including a plurality of permanent magnets and a plurality of field or excitation windings through which current flows.

7. The method according to claim 5, which further comprises: producing the excitation field of the generator by using a purely electrical excitation.

8. The method according to claim 1, which further comprises: operating the wind energy installation in the control or operating mode with the variable rotor speed and the variable turbine rotational speed such that the wind energy installation is controlled at a maximum power production point.

9. The method according to claim 1, which further comprises:

operating the wind energy installation in the control or operating mode at the fixed turbine rotational speed ω^*; and

controlling the fixed turbine rotational speed ω^* to be a maximum permissible turbine rotation speed ω^*.

10. The method according to claim 1, which further comprises:

during continuous operation, alternately switching the wind energy installation between the control or operating mode with the variable rotor speed and the variable turbine rotational speed ω and the control or operating mode at the predetermined fixed turbine rotational speed ω^*, as a function of a generator power P_G and prevailing wind conditions, as a function of a predetermined power-related hysteresis range or band, and as a function of a selected control or operating mode.

11. The method according to claim 1, which further comprises:

determining an electrical generator power P_G from terminal voltages and machine currents;

comparing the electrical generator power P_G with a predetermined power range and/or power-related hysteresis band;

as a function of the comparing step, choosing either the control or operating mode with the fixed rotational speed ω^* or the mode with the variable turbine rotation speed ω, and determining a reference power P_G^* corresponding to a maximized power production;

obtaining a power difference by comparing the reference power P_G^* with the electrical generator power P_G and producing a reference current I_E^* proportional to the power difference;

supplying the reference current I_E^* to the field controller for adapting an excitation for the generator, the reference current I_E^* causing the field controller to draw power in a controlled manner from a capacitive DC voltage intermediate circuit and to supply the power to the excitation field of the generator for adapting the excitation field of the generator; and

changing the torque of the generator such that the electrical generator power P_G corresponds to the reference power P_G^*, resulting in the rotational speed ω being controlled and a

power produced by the wind energy installation being controlled and optimized.

12. The method according to claim 11, which further comprises:

using a lower power threshold value and an upper power threshold value to define the predetermined power range and/or the predetermined power-related hysteresis band.

13. The method according to claim 12, which further comprises:

in the control or operating mode with the variable turbine rotational speed, until the upper power threshold value of the predetermined power-related hysteresis band is exceeded by the electrical generator power P_G, determining the reference power P_G^* using a following relationship:

$$= \left[0.5 \cdot C_{p,\max} \cdot \rho \cdot A \cdot \left(\frac{R}{\lambda_{opt}} \right)^3 \right] \cdot \omega^3 = K_{p,opt} \cdot \omega^3 ,$$

ω being the rotational speed of the wind turbine, $C_{p,max}$ being the maximum power coefficient, A being an area over which wind flows, R being a radius of the rotor, λ_{opt} being an optimum

speed coefficient, ρ being an air density assumed to be constant, and $K_{p,opt}$ being a characteristic value specific for the wind energy installation.

14. The method according to claim 12, which further comprises:

between the generator power P_G exceeding the upper power threshold value of the predetermined power-related hysteresis band and the electrical generator power P_G falling below the lower power threshold value, keeping the turbine rotational speed ω constant at the fixed rotational speed ω^*, which is a maximum permissible rotation speed value, by using the control apparatus to vary the excitation field and hence the generator torque and to generate a corresponding reference power $P_G^* = P\omega,\omega^*$; and

not changing the wind energy installation to the control or operating mode with the variable wind turbine rotational speed ω until the generator power P_G falls below the lower power threshold value.

15. The method according to claim 1, which comprises:

forming a group of wind energy installations by using a capacitive DC voltage intermediate circuit to couple a plurality of wind energy installations without gearboxes;

varying a voltage level of the DC voltage intermediate circuit as a function of a mean wind speed to prevent a discontinuous current waveform from the generator at low wind strengths;

recording a wind speed at each of the plurality of wind energy installations within a wind park and passing the wind speed to the control apparatus;

obtaining a filtered mean wind signal by determining a mean wind speed from individual information items using the control apparatus and smoothing a resultant signal using a low-pass filter;

varying a voltage from the DC voltage intermediate circuit, which is used as a reference voltage U_{dc}* for a respective inverter unit on a grid side, as a linear function of the filtered mean wind signal; and

varying a voltage U_{dc} of the DC voltage intermediate circuit using an active inverter on the grid side.

16. The method according to claim 1, which further comprises: keeping a voltage U_{dc} of a DC voltage intermediate circuit constant.

17. The method according to claim 1, which further comprises:

using sliprings to provide an electrical supply for field or excitation windings of a rotor of the generator.

18. The method according to claim 1, which further comprises:

without using sliprings, using a transformer to provide an electrical supply for field or excitation windings of a rotor of the generator.

19. The method according to claim 1, which further comprises:

forming a group of wind energy installations by using a capacitive DC voltage intermediate circuit to couple a plurality of wind energy installations without gearboxes;

using a diode rectifier to rectify electrical output power generated by the generator of at least one of the plurality of wind energy installations; and

introducing the electrical output power into the common capacitive DC voltage intermediate circuit to pass on the electrical output power with low losses.

20. The method according to claim 1, which further comprises:

forming a group of wind energy installations by using a capacitive DC voltage intermediate circuit to couple a plurality of wind energy installations without gearboxes;

providing at least one active inverter unit coupled to a side of the capacitive DC voltage intermediate circuit opposite the plurality of wind energy installations;

providing at least one transformer connected downstream from the inverter unit; and

drawing electrical power from the capacitive DC voltage intermediate circuit and using the transformer to and the inverter unit to feed the power into a group grid system.

21. The method according to claim 1, which further comprises:

providing the control apparatus with a control module; and

using the control module for open-loop control, closed-loop control and monitoring of the generator unit.

22. The method according to claim 21, which further comprises:

recording machine currents, terminal voltages and a rotational speed ω of the generator;

obtaining a resultant power signal by determining an electrical power P_G of the generator;

filtering the resultant power signal to obtain a determined electrical power P_G;

generating a reference power P_G*, and controlling the rotational speed ω of the generator as a function of the determined electrical power P_G and a predetermined power-related hysteresis band;

obtaining a power difference by comparing the reference power P_G* with the electrical power P_G;

producing a reference current I_E* being proportional to the power difference;

supplying the reference current I_E* to the field controller; and

supplying the reference current I_E* to a higher-level control module of the control apparatus.

23. The method according to claim 22, which further comprises: performing the step of controlling the rotational speed ω of the generator such that the rotational speed ω of the generator is at a maximum permissible value ω*.

24. The method according to claim 1, which further comprises:

forming a group of wind energy installations by using a capacitive DC voltage intermediate circuit to couple a plurality of wind energy installations without gearboxes;

providing a plurality of active inverter units coupled to a side of the capacitive DC voltage intermediate circuit opposite the plurality of wind energy installations;

providing the control apparatus with a plurality of control modules and a higher-level control module interacting with the plurality of control modules; and

using each one of the plurality of control modules for monitoring, closed-loop controlling, and open-loop controlling a respective one of said plurality of active inverter units.

25. The method according to claim 24, which further comprises:

using each one of the plurality of control modules for recording and further processing a voltage of the capacitive DC voltage intermediate circuit, a grid voltage and a grid current.

26. The method according to claim 24, which further comprises:

providing each one of plurality of wind energy installations with a generator unit;

providing the control apparatus with a higher-level control module communicating with the plurality of control modules;

providing the control apparatus with a plurality of second control modules, each one of the plurality of second control modules for controlling the generator unit of a respective one of plurality of wind energy installations;

configuring the higher-level control module for communicating with the plurality of the second control modules; and

when a fault occurs, using the higher-level control module for tripping or activating appropriate protective apparatuses.

27. The method according to claim 26, which further comprises: providing the protective apparatuses as circuit breakers and DC choppers.

28. The method according to claim 24, which further comprises:

recording wind speeds at each one of the plurality of the wind energy installations and obtaining a signal by averaging the wind speeds using the higher-level module in the control apparatus; and

obtaining a filtered signal by filtering the signal and then transmitting a corresponding signal to at least one of the plurality of control modules, which then generates a corresponding reference voltage U_{dc}* and passes the reference voltage U_{dc}* to one of the plurality of active inverter units.

29. A configuration for electronically controlling at least one wind energy installation, the configuration comprising:

said wind energy installation being configured without a gearbox, said wind energy installation including a wind turbine having a generator unit circuit coupled to said wind energy installation; and

at least one modular control apparatus for data recording, processing and controlling said generator unit.

30. The configuration according to claim 29, further comprising a plurality of electronic components being controlled by said modular control apparatus.

31. The configuration according to claim 29, further comprising:

a plurality of wind energy installations, each one of said plurality of wind energy installations being configured without a gearbox, each one of said plurality of wind energy installations including a wind turbine having a generator unit with a synchronous generator, a diode rectifier, and a field controller;

said capacitive DC voltage intermediate circuit coupling said plurality of wind energy installations to form a group.

32. The configuration according to claim 31, wherein: said plurality of wind energy installations are located on an ocean and close to a coastline.

33. The configuration according to claim 29, further comprising:

at least one transformer; and

at least one inverter unit having a DC voltage side connected to said capacitive DC voltage intermediate circuit, said inverter unit having an AC side connected to said transformer;

said synchronous generator having a mixed excitation system with a plurality of permanent magnets and a plurality of electrically supplied field or excitation windings;

said diode rectifier having an AC side connected to said synchronous generator;

said diode rectifier having a DC voltage side connected to said capacitive DC voltage intermediate circuit;

said synchronous generator connected directly to said wind turbine, without any intermediate gearbox;

said field controller for supplying said plurality of field or excitation windings;

said field controller having an input connected to said capacitive DC voltage intermediate circuit; and

said field controller having an output connected to said plurality of field or excitation windings.

34. The configuration according to claim 29, further comprising:

at least one transformer; and

at least one inverter unit having a DC voltage side connected to said capacitive DC voltage intermediate circuit, said inverter unit having an AC side connected to said transformer;

said synchronous generator having an exclusively electrically supplied excitation system with a plurality of electrically supplied field or excitation windings;

said diode rectifier having an AC side connected to said synchronous generator;

said diode rectifier having a DC voltage side connected to said capacitive DC voltage intermediate circuit;

said synchronous generator connected directly to said wind turbine, without any intermediate gearbox;

said field controller for supplying said plurality of field or excitation windings;

said field controller having an input connected to said capacitive DC voltage intermediate circuit; and

said field controller having an output connected to said plurality of field or excitation windings.

35. The configuration according to claim 29, wherein said synchronous generator has sliprings.

36. The configuration according to claim 29, wherein said synchronous generator is a three-phase synchronous generator and said diode rectifier includes a three-phase diode bridge.

37. The configuration according to claim 29, further comprising at least one three-phase transformer.

38. The configuration according to claim 29, wherein said synchronous generator is an internal pole machine.

39. The configuration according to claim 29, wherein said synchronous generator has a large number of poles.

40. The configuration according to claim 29, further comprising:

at least one active inverter configured as a two-point or multipoint inverter fitted with a plurality of thyristors;

said active inverter being configured on a side of a grid.

41. The configuration according to claim 40, wherein each one of said plurality of thyristors is selected from a group consisting of IGCTs, GTOs, ETOs, MCTs or MTOs.

42. The configuration according to claim 29, further comprising:

at least one active inverter configured as a two-point or multipoint inverter;

said active inverter being configured on a side of a grid;

said active inverter being fitted with transistors.

43. The configuration according to claim 29, further comprising:

at least one active inverter configured as a two-point or multipoint inverter;

said active inverter being configured on a side of a grid;

said active inverter being fitted with IGBTs.

44. The configuration according to claim 29, further comprising:

at least one active inverter configured as a two-point or multipoint inverter;

said active inverter being configured on a side of a grid;

said active inverter being fitted with SiC semiconductor switches.

45. The configuration according to claim 29, further comprising:

a blocking diode connected between said diode rectifier and said capacitive DC voltage intermediate circuit;

said diode rectifier having a diode bridge;

said blocking diode for protecting said diode bridge of said diode rectifier;

said blocking diode having a forward-biased direction pointing from said diode rectifier toward said DC voltage intermediate circuit.

46. The configuration according to claim 29, further comprising:

at least one active inverter configured on a side of a grid, said active inverter having a DC side; and

a circuit breaker configured between said capacitive DC voltage intermediate circuit and said DC side of said active inverter.

47. The configuration according to claim 29, wherein:

said capacitive DC voltage intermediate circuit includes at least one capacitor bank connected in parallel with said generator unit;

said capacitor bank formed as an intermediate circuit capacitor.

48. The configuration according to claim 29, wherein said capacitive DC voltage intermediate circuit has at least one DC chopper.

49. The configuration according to claim 29, wherein said control apparatus has at least three differently configured control module groups or assemblies.

50. The configuration according to claim 29, further comprising:

a plurality of wind energy installations, each one of said plurality of wind energy installations being configured without a gearbox, each one of said plurality of wind energy installations including a wind turbine having a generator unit with a synchronous generator, a diode rectifier, and a field controller;

said capacitive DC voltage intermediate circuit coupling said plurality of wind energy installations to form a group;

said modular control apparatus including a plurality of control modules; and

each one of said plurality of control modules for separately controlling said synchronous generator of a respective one of said plurality of wind energy installations.

51. The configuration according to claim 29, further comprising:

at least one active inverter configured on a side of a grid;

said control apparatus including a control module and a higher-level control module;

said control module for recording information about said higher-level control module, said control module for recording currents and voltages on said side of said grid, and said control module for recording a voltage in said DC voltage intermediate circuit at said active inverter;

active inverter having equipment components; and

said control apparatus for further processing the currents and the voltages, and for passing resultant information or reference values for control purposes to said equipment components of said active inverter and to said higher-level control module.

52. The configuration according to claim 29, further comprising:

a plurality of wind energy installations, each one of said plurality of wind energy installations being configured without a gearbox, each one of said plurality of wind energy installations including a wind turbine having a generator unit with a synchronous generator, a diode rectifier, and a field controller; and

a plurality of inverter units;

said capacitive DC voltage intermediate circuit coupling said plurality of wind energy installations to form a group;

said control apparatus including at least one higher-level control module, a plurality of control modules for said generator unit of said plurality of wind energy installations, and a plurality of control modules for said plurality of inverter units;

said higher-level control module communicating with said plurality of control modules for said generator unit of each one of said plurality of wind energy installations;

said higher-level control module communicating with said plurality of control modules for said plurality of inverter units;

said higher-level control module configured for recording information or data from external sensors and for further processing the data; and

said higher-level control module configured for supplying instructions resulting from the data appropriate control apparatus and equipment components.

53. The configuration according to claim 29, wherein said control apparatus includes a control module with at least one digital signal processor.

54. The configuration according to claim 29, further comprising:

a switching station located on land or on a coastline;

a plurality of active inverter units;

a plurality of control modules associated with said plurality of active inverter units, said plurality of control modules located in said switching station; and

a plurality of transformers and a higher-level control module located in said switching station.

55. The configuration according to claim 29, further comprising:

a control module integrated in said generator unit or located at least immediately adjacent said generator unit.

56. The configuration according to claim 29, wherein said capacitive DC voltage intermediate circuit has a DC power cable with a length of from several hundred meters to several thousand meters.

57. The configuration according to claim 29, wherein said capacitive DC voltage intermediate circuit includes an underwater DC power cable.

58. The configuration according to claim 29, wherein said modular control apparatus controls a rotational speed of said generator unit.